

Global Software Development Challenges of Software Product Quality in Organizations

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Global Software Development (GSD) leaders in organizations encountered low software product quality due to the challenges that negatively impact customer satisfaction, global economic stability, business finance performance, and public safety. The qualitative multiple case study presented a common understanding shared by 30 managers in Canadian GSD organizations and how to improve software product quality and customer satisfaction through interviews. The eight themes emerged from the study include the developing a clear purpose and work principles, improving processes and employee skills, developing adequate personnel management strategies, promoting autonomy and personal worker development, formulating life cycle and development techniques, identifying challenges, formulating solutions, and focusing on product quality. The results highlighted the need to increase best management and industry practices among GSD organizational leaders to achieve software product quality, customer satisfaction and prevent global software development project failures.

Keywords: leaders, global software development, organization, management, product quality, processes, customer satisfaction

INTRODUCTION

A shift from centralization to distributed software development is rapidly growing in software engineering due to the benefits; cost and time savings, improve quality and availability of cheap skilled labor (Alzaidi & Qureshi, 2014). These competitive advantages gave software development in a geographical environmental setting business outstanding strategy. Due to software product increase in demand and requirements, it becomes imperative for organization to improve resource need. The software development structure in organization now required more responsibility due

to increasing software product use in almost all areas of life such as health care, transportation, aviation, communication, manufacturing, education, defense and household devices (Miguel, Maurico, & Rodriguez, 2014). Identified by researchers were poor software product evaluation, measurement, reliability and security concerns. Hossain (2018) noted that software product quality is critical in software development industry because of poor software quality, measurement and evaluation. Higher standard requirement is placed on software quality because of software sensitivity in some departments such as banking, health care, aviation and security where common mistakes could result into costly consequences (Rodriguez, Oviedo, & Piattini, 2016). The implication of software project failure and cost of resolving errors is acknowledge as notable in the industry. Practitioners and researchers are strongly inclined by finding solutions by developing software product quality management system models and frameworks. Software development cost is mostly spent on identifying errors, correcting and debugging (Hossain, 2018). The initiative for high rating score and proper implementation quality assurance helps prevent defective software (Shen, Ding, Ren, & Yang, 2018)

The Global Software Development (GSD) challenges in organization negatively impacted software product quality and achieving customer expectations. This prompted this qualitative research to help reveal common understandings among GSD managers in organizations. Findings from this research are significant because common understandings of what GSD organizational leaders need to achieve software product quality and customer satisfaction in Canadian GSD organizations were derived. The data from participants in this study represented insights on what knowledge, skills, and strategies are needed to solve some of the management problems of global software development distributed setting. The recommendation was that GSD organizational leaders should commit to good management behaviors and best practices, according to Deming's 14 principles of quality management (Deming, 1986). The research delimitation may suggest that number of participants not adequate representation of the population because some provinces in Canada were left out of the study. The included provinces were Ontario, Alberta, Manitoba, Quebec, Saskatchewan, and British Columbia. The remainder of this research presents the problem with supporting literature, research questions, significance of the problem, research methodology, discussion of results, recommendation and conclusions.

BACKGROUND

The increased demand for software product quality led to several emerging software development life cycle (SDLC) models and certifications. Capability maturity model (CMM) for software, capability maturity model for integration (CMMI), International Organization for Standardization (ISO) 15504, ISO 12207, ISO 900, and International Organization for Standardization and International Electrotechnical Commission (IEC) 25000 series defined framework for software quality product and evaluation (Rodriguez et al., 2016). Evolution of software quality culture continued and researchers strived and shifted from improving the processes to software product quality. Poor-quality culture was identified as a frequent and most challenging issue in software engineering (Usman & Khan, 2018). Researchers attested that the most effective development approaches may still encounter software failure due to complex environmental factors. Alfaro and Chandrasekaran (2015) investigated how the national blend created impediments to information flow among GSD multisite teams. The qualitative research results analysis concluded that significant software quality effects and team working tie concerns.

The early inclusion of quality management in every stage of software development is important in GS. Bergmane, Grabis, and Zeiris (2017) identified human errors, complex code, and new technologies as possible root causes of software defects using the Ishikawa technique. Documentation and continuous monitoring of software product life cycle processes were derived from an empirical evaluation of software quality assurance by Sowunmi, Misra, Fernandez-Sanz, Crawford, and Soto (2016) in developing countries such as Nigeria and Turkey. Akbar, Shafiq, Kamal, and Hamza (2019) asserted that change management requires periodic, continuous updates to the product life cycle to meet customer expectations. Software quality considerations at all stages, such as planning, design, and execution, are aimed at reducing defects

and costs (Alebebisat, Alhalhouli, Alrawashdeh, & Alshabat, 2018). Management software quality issues among outsourcing team are communication and coordination barriers (Ali et al., 2019).

Globalization was cited as a problem for a distributed GSD team. Bhatti and Ahsan (2016) noted globalization as a vital indicator in the process of GSD distributed team's setting and the effects of human resource management. Contemporary Studies identified process improvement as a challenge in GSD. Vrhovec, Kumer, Trkman, and Krisper (2015) studied three sites on the transition of economics and GSD approach. Their findings showed that outsourcing to remote developers in GSD compensated for a lack of skilled information and communication technology (ICT) professionals. Usman and Khan (2018) asserted that software quality is a major challenge for vendor organizations in satisfying customer expectations. The issue of fear of losing reputation, software defects and failures is on the rise in organizations. Rehman and Khan (2014) stated that modern organizations sometimes compromise software quality practice for a cost reduction, meeting schedule, high productivity, and other benefits. Empirical research in GSD that could help provide solution to the problem of low software product quality is immature and still evolving (Wickramarachchi & Lai, 2016). Empirical research on GSD software quality product is scarce (Chadli et al. 2016). Influence of organization structure for a distributed team affects quality of software products (Brooks, 1995). Therefore, strong leadership in organization is required for effective communication and coordination. Nagappan, Murphy, and Basili (2008) confirmed that GSD projects fail mainly because of poor communication, coordination, and a lack of trust with key stakeholders; other success and failure factors of GSD include culture, geographical distance, and time zone differences. Jabangwe, Borstle, and Petersen (2014) noted that few empirical studies have reported about GSD challenges and the severity software quality. Research work on evaluation and prediction of quality in a global environment is immature (K. Khan, Khan, Aamir, Zulfikar, & Khan, 2013).

Customer satisfaction is identified as the main concern of software developers, as organizations' strategies focus on building economical software within budget and schedule. Shen et al. (2018) concluded that guaranteed software quality is achievable by software quality level, quality evaluation, and check procedure management. The use of software has become almost mandatory, due to high demand for software used in nearly all human endeavors (Saleem, Mathrani, & Taskin, 2019). Most business organizations use information technology (IT) to gain competitive advantages, operational efficiency, productivity, and quality of service (John, Kadadevaramath, & Immanuel, 2016). Despite the rapid increase in software demand and software firms, software engineering is relatively new with respect to the design, development, and maintenance stages (Gheorghe, 2015). In the study, common understanding stemmed from what leaders in GSD organizations in Canada experienced to mitigate low software product quality, meeting customer satisfaction goals. GSD standards on quality provide valuable inputs to help practitioners make better decisions about the management of future projects (Gheorghe, 2015).

PROBLEM

Despite the advancement of global software development in organization distributed environmental setting and adoption of several software quality product frameworks for software development product life cycle. There are still challenges on poor software quality product, software project failures and inability to achieve customer expectations. Fast GSD growth created problem of complexities, identification, evaluation, and measurement of software quality (Miguel et al., 2014). Studies and reports showed that software defects and failures affect the cost of business objectives, reputation of organizations and world economies. Additional negative effects are reduced customer satisfaction, reliability and maintainability issues in GSD organizations and software end-users (Hussain, Farid, & Mumtaz, 2019). The specific management problem addressed in the research was a lack of common understanding among GSD organizational leaders. Other identified research limitations include the scarcity of software product quality research, its narrow focus, and its under-researched, limited-empirical approach (Jabangwe et al., 2014; Niazi, Mahmood, Alshayeb, & Hroub, 2016; Wickramaarachchi & Lai, 2016). Chadli et al. (2016) concluded that the absence of mature research and an all-inclusive quality model for evaluating and measuring the impact of defects on software quality products is a failure factor.

The research problem and research purpose were addressed by developed three research questions, one overarching main research question and two other research questions.

The following developed research questions guided the study:

- **First research question:** What are the common understandings required by Canadian GSD organizational leaders to ensure software product quality and customer satisfaction?
- **Second Research question:** How can common understandings be achieved among GSD organizational Leaders?
- **Third Research question:** How do GSD organizational Leaders predict software product quality outcome and process improvement?

RESEARCH METHODOLOGY AND DESIGN

The qualitative research study was conducted using semi structured opened ended interviews protocol through telephone and audioconference tools such as Zoom, Webex, or Skype along with the review of related literature, were used to gather data. The research population comprises 200 Canadian organizations, with a sample of 30 participants from six companies across six Canadian provinces. The qualitative case study has criteria for sample size based on the notion that a sufficient sample size yields sufficient information to achieve research objectives (Yin, 2017). Denzin and Lincoln (2011) affirmed that the adopted qualitative approach is flexible, involves human interactions, is nonrandom in nature, and is in-depth, capable of generating rich descriptions of phenomena. The semistructured interviews enable flexibility and consistency in a qualitative study (Dikko, 2016; Dunn, Margaritis, & Anderson, 2017). Open-ended interview questions, document review and contextualized data helped derived ideas, views, opinions from participants (Patton, 2015). Similarly, Padgett, Gossett, Mayer, Chien, and Turner (2017) adopted semistructured interviews in their qualitative research to better understanding a phenomenon in a high reliability organization.

The case study design was deemed the most appropriate for this study because it is encompassing and provides comprehensive, in-depth analysis of the views of GSD organizational managers in a distributed team setting. Information was obtained from participants during the interviews. Cornelissen (2016) stated that rich and thick explanations may lead to an answer to the research question originating from research participants. The adoption of appropriate research methodology and effective strategy to select participants ensured credibility. Alignment of data collection process with a consistent protocol enhanced data data dependability. The study present protocol with open-ended interview questions based on the Tamimi et al. (1995) modified validated instrument for Deming's 14 points. The instrument help provided rich protocol, in-depth exploratory advantage that helped discovered common knowledge among managers in GSD organization and also provided answers to research questions on how GSD organizational leaders predicted software quality product using the SDLC, existing software models and standards.

Informed consent approved procedures guide the researcher and the participants. The procedure was obtained from Walden University IRB to ensure best practices. In order to ensure consistency and validity, the research informed consent form complied with the IRB protocol standards. The informed consent form consisted of various parts: Introduction, interview ground rules, and a confidentiality statement (Creswell, 2014; Patton, 2015; Lunnay et al., 2015). Merriam and Tisdell (2016) noted that criteria-based selection is necessary for sample determination. The GSD managers selection criteria was based on participant experience with GSD for a minimum of 6 years, competency, responsibility, commitment, and integrity. Other used criteria were certification and demonstration of knowledge of GSD

Interview sessions were audio-recorded with verbatim transcriptions. All participants had the opportunity to listen to and review the data for accuracy and provide feedback. Transcribing all interviews and asking participants to review their transcript and the initial interpretations of data provide authentic dialogue. The use of a dialogue strategy between the researcher and the participants is valuable in a research process (Harvey, 2015). The transcribed reviews were loaded into NVivoTM12 software for coding, categorization and content analysis. Qualitative software reduces the burden of data management and analyses (Fielding, Fielding, & Hughes, 2013). The use of computer-assisted qualitative data analysis helps

manage large volumes of data, improve data quality, and enhance trustworthiness (Houghton et al., 2017). The software enhances the coding process, which stores, organizes, manages, and configures the data for improvement, and better interpretation (Strauss & Corbin, 1998). Applied data triangulation improved the quality of findings from research data. The use of different data sources leads to comprehensive findings and greater credibility (Noble & Smith, 2015). The sequential steps that guided the study are explained in the next section.

RESULTS

The results of the qualitative research originated from participants' interview responses. This section presents the eight primary themes that emerged during the thematic data analysis of the interviews. Adoption of thematic analysis approach for data analysis was because of the methodical attributes. Data source triangulation for this study included data derived from interviews and document reviews. Studies showed that multiple sources of data enable researchers to have rich evidence that help answer research questions. The sequential steps that guided the study are explained in the next section. Table 1 includes eight themes that emerged from the data analysis to answer the research questions. Data were from the expressed perspectives and experiences of managers in Canadian GSD organizations and related documents. Results from analysis of the data collected from 30 participants from six organizations across six provinces include the aforementioned pseudonyms for the 30 interviewees (AP1-AP5, BP1-BP5, CP1-CP5, DP1-DP5, EP1-EP5, and FP1-FP5). The six-step thematic analysis process by Braun and Clarke (2019) was useful for this study's qualitative data analysis. Based on the two interview sections used in this study, different codes emerged, as summarized in Table 1. Codes stemmed from the inclusion of words and phrases that all 30 participants used when answering the interview questions.

TABLE 1
CODE IDENTIFIED FROM THE INTERVIEW DATA

Codes	Contributing participants	Interview questions
Creating constancy of purpose, adopting the new philosophy, ceasing inspection and requiring evidence, improving supply quality supplies, continuously improving production, training and educating employees, supervisors helping employees, driving out fear, eliminating boundaries, eliminating the use of slogans, eliminating numerical standards, allowing employees to be proud of their work, encouraging self-improvement, and committing to the ever-improving quality	30	Interview section A: Deming's 14 principles of quality management
Software development lifecycle, software development method, potential hurdles, new practices, the solution to problems, Deming's Quality management used in GSD, quality management method, predictive software product quality, software quality management, internal and external software quality, product quality, covering quality aspects	30	Interview section B: SDLC or ISO/IEC 25000 quality series

The process of generating themes entailed examining the created codes and identifying common patterns among them, and in the process formulating important themes from the obtained interview responses. Several codes combined to form a single theme as presented in Table 2. Following the iterative process, eight themes emerged from the data, as follows: (a) develop clear purpose and work principles, (b) improve processes and employee skills, (c) develop adequate personnel management strategies, (d) promote autonomy and personal worker development, (e) formulate life cycle and development techniques, (f) identify challenges, (g) formulate solutions, and (h) focus on product quality. The identification of all the eight themes was contingent upon the contributions from all the 30 participants to the coded categories, such that every participant contributed to the data that led to each emergent theme.

TABLE 2
EMERGENT THEMES FROM CODED INTERVIEW DATA

Coded categories	Themes	Interview questions
Create constancy of purpose, adopt new philosophy, cease inspection, require evidence.	Develop clear purpose and work principles	Interview section A: Deming's 14 principles of quality management 30 participants identified each theme
Improve the quality of supplies, continuously improve production, train-educate workers.	Improve processes and employee skills	
Supervisors must help people, drive out fear, eliminate boundaries, eliminate the use of slogans, eliminate numerical standards.	Develop personnel Management Strategies	
Let people be proud of their work, encourage self-improvement, and commit to the ever-improving quality.	Promote autonomy and personal worker development	
Software development lifecycle, Software development method.	Formulate lifecycle and development techniques	Interview section B: SDLC or ISO/IEC 25000 quality series 30 participants identified each theme
Potential problems and hurdles, limitations to effective processes.	Identify challenges	
Develop new practices, identify the solution to problems.	Formulate solutions	
Demin's quality management in GSD, quality management method; predictive software product quality, software quality management, internal and external software quality, product quality, covering quality aspects.	Focus on product quality	

Research Question 1

The first central research question was: What are the common understandings required by Canadian GSD organizational leaders to ensure software product quality and customer satisfaction? The subsequent subsections include the discussion of the first four main themes identified in the data from the interview responses, summarized in Table 3. These first four themes include the need by organizational leaders to develop clear purpose and working principles, improve processes and employee skills, develop adequate personnel management strategies, and promote autonomy and personal development.

TABLE 3
THEMES: SOFTWARE PRODUCT QUALITY

Themes	Issues
Develop clear organizational purpose and work principles	Communicate aim and purpose, regular training, constant inform sharing, publish new products, include quality into the process, improve quality of incoming materials, do not rely on prices alone, minimize costs, work with single suppliers
Improve internal processes and develop employees' skills	Promote skills development, budget allocation for training, on-the-job training, external training, online training, continually improve quality and services, reduce costs and errors
Develop appropriate personnel management strategies	Eliminate fault-finding, promote a positive environment, checks and controls, eliminate fear, create trust, formulate support systems, provide feedback
Promote autonomy and personal worker development	Address unhealthy competition, promote autonomy in individual goals, facilitate education and knowledge, management commitment to improvement and learning

Theme 1: Develop Clear Organizational Purpose and Work Principles

To meet software product quality in Canadian GSD organizations, the interviewees shared that leaders need to develop clear purpose and working principles. In meeting this goal, GSD organizational leaders expressed the need to focus on three factors: (a) creating constancy of purpose in product and service improvement to stay in business, become competitive, and provide jobs; (b) adapting new philosophy; (c) ceasing dependence on inspection as a way of achieving quality; and (d) improving the quality of incoming material instead of awarding operations based on price. First, regarding creating constancy of purpose, the interviewees share that organizations need to inform all employees about the purpose and aim of the organization.

These observations were evident during the interview responses. For example, AP5 shared that “Top management documents the short and long-term plans in the company strategic plan and organization quality plan. Trainings are organized for employees through inductions, seminars, workshops and virtual online courses.” BP3 said, “When the top management wants to introduce a new software product, so there's always a campaign through emails. Before they select the product, everyone is informed that there is a new product to be introduced.” AP2 shared that constancy of purpose is achieved through information sharing and “employee training where managers recommend the people within the team or inform everyone there is a new development or new application.” CP1 further noted that, “awareness and training are put in place, in addition to dialogue with the external consultants to see how we can provide awareness training for our developer.” Similar observations on the need to create and publish the aim and purpose emerged from the data provided by other interviewees, including DP 2, DP4, EP1, EP3, EP5, FP1, and FP4, in which constancy of purpose was central to organizational success in product quality development.

Second, interviewees noted that organizational leaders need to adopt a new philosophy about technology. The specific focus was on ensuring everyone learns the new philosophy, emphasizing defect prevention rather than defect detection. Everyone should be involved in the quality journey. These insights were shared by interviewees, such as AP1, BP3, CP 1, DP 4, AP2, EP1, EP3, FP2, and FP5. For example, AP1 said, “One of the goals is to make sure that once new technology comes in, over 80 per cent of our employees are trained. We motivate them to be able to achieve this.” BP3 claimed, “There's always a set of

individuals that always review the process, and always examine how things could be better improved.” CP1 explained that, “commitment for quality and regular learning is very important because events have shown us that when we don't address quality especially at the initial phase for application development.”

Third, participants, such as AP1, AP2, BP1, CP1, DP3, EP1, DP1, EP4, FP3, and FP5, shared that organizational managers need to stop relying on inspection as a way to achieve quality. Instead, participants indicated that leaders should ensure quality is built into the product planning process. Most participants considered the mass inspection unreliable and time-consuming. Instead, efforts need to reduce failures and subsequently eliminate acceptance sampling. For example, AP2 shared that, “If you don't include the quality at the beginning that means you are going to be patching the software as you go along. So, ensure that when they are doing the design, everything is about quality.” CP5 said, “Our top management ensure the building of quality at every developmental phase. They do not wait until the end before implementing the quality of the product. This will be a disaster should we wait.” DP3 explained, “In this regard, you don't want to put quality as adding special things, it must be built-in. What I mean by that is that quality must be built right from the beginning.” According to EP4, “quality has to be built into the planning process to start with and throughout the software development life cycle.” Similar observations were also made by EP 5 who noted that “mass inspection costs more because you have to start inspecting this product one after the other, quality need to be included from the study to avoid mass inspection.” FP3 also shared that, “in terms of quality for procurement perspective, you ensure that you have the necessary SLAs in place and you are also ensuring that you have factored in quality testing as part of the engagement.” These observations revealed that GSD leaders need to ensure that quality is built-in at every stage of software development to achieve product quality.

Fourth, interviewees also agreed that GSD leaders need to focus on the quality of incoming materials rather than basing their awards solely on price. That is, there need to be meaningful quality measures, along with prices. Also, there is a need to minimize total costs by working with a single supplier. For example, CP1 noted that “we usually go by quality because of the better quality sometimes, the higher the price and so, we use an evaluative method to address those two variables in terms of selecting our suppliers.” FP2 shared that “quality is rated higher than the price in my present and previous organization because of the problem of poor quality of software.” AP4 shared that, “Every company must have its method to examine quality. They look at the price, too. Every company has the criteria that they use to select vendors.” AP5 said, “Both quality and price are used to determine potential suppliers.” BP1 explained, “Price is sometimes, it's not the primary factor in the selection of suppliers. In a long time, relationship, quality of their services, reputation, integrity and all these things are a very big factor in selecting those suppliers.” BP5 similarly stated, “Quality is taken of high important before price, though the price is equally important in decision and selection of suppliers.”

Theme 2: Improve Processes and Develop Employees' Skills

Interviewees also agreed that organizations are more likely to succeed if they improve internal processes and enhance employee skills. The GSD leaders may achieve this goal through two main approaches: (a) institute on-the-job training and (b) constantly improve the system of services and products. First, participants agreed that GSD leaders need to train and educate workers to ensure they can perform their jobs correctly. For example, AP5 shared that, “Management establish quality management awareness training for all employees, defined and organize as needed skill training for employees. Recommend online specific periodic training for the upgrade of knowledge.” CP3 said, “On an annual basis, the top management allows the team to go lookout for certain training, relevant training that has reviewed and approved. And they can go for the training be it online, be it physical training.”

Interviewees also emphasized that GSD leaders need to ensure constant improvement processes to achieve product quality. According to FP2, “there is a need to identify problems and constantly work towards better systems of service delivery and production.” BP2 noted the need to ensure “continuous reduction of waste and facilitation of quality improvement in every process.” Also, EP4 indicated that an organization needs to work towards “decreasing costs of productivity and regularly improve each planning process.” CP3 also claimed, “We constantly check each of the functionalities to see if it meets the

requirements. If it doesn't, we go back to the vendor. So, a vendor keeps doing that until he gets it right.” DP1 said, “When you put software out on the market, people subscribe to it. Then you open what they call a feedback loop. ... you want the response of the users that are using your software for continuous improvement.”

FP5 shared, “We perform frequent engagement by in-person meetings or virtual meetings or conferencing to gather requirements. We also get feedback, in the same way, to keep improving.”

Theme 3: Develop Appropriate Personnel Management Strategies

Effective worker management is key to long-term success in product quality. Findings from interview responses included the need for GSD leaders in the organization to have adequate leadership, build trust and confidence among workers, eliminate fear, and optimize team productivity. Interviewees shared that adequate personnel management strategies may be realized through (a) teaching and instituting proper leadership; (b) driving out fear and creating trust; (c) optimizing the efforts of staff, groups, and teams; (d) eliminating targets, exhortations, and slogans based on zero defects; and (e) eliminating work standards and numerical quotas on employees based on quantity and focusing on quality.

Insights from DP2 indicated that GSD organizational leaders need to improve their supervisory skills rather than focusing on “fault-finding and negative attitude.” Participants AP4, BP1, CP3, and EP4 also emphasized that supervisors need to ensure a supportive and positive atmosphere. Thus, these interviewees felt that the GSD leaders should teach and institute appropriate leadership when leading their employees. For example, BP3 shared that, “It's the manager's job to ensure that the employees in a project are adequately supported and led towards achieving organizational and product quality goals.” CP3 said, “Usually supervisors need to have certain skills, management skills, people skills.” CP3 added, “And it's one basic requirement for recruiting supervisors and leaders and team leads because they need to be able to bring out the best in the team and manage the team.”

The GSD leaders further need to drive out fear, create a conducive climate for innovations, and create trust. According to AP3, DP1, EP5, and FP3, working in fear stifles creativity among employees. Thus, productive outcomes are met when there is effective two-way communication. CP3 shared that “when employees have issues in certain fields, leaders need to be open enough to assist.” Such an approach may relieve individuals' fear of job loss and change, and ensure that performance appraisals do not hinder employee productivity. According to CP1, organizations can create trust by creating “a knowledge management share point site, where employee express their ideas and other work to make work easier.” Further, BP3 noted that there should be checks and balances where “effective controls must ensure that at any point in time the employee is heard, or employee is not working under fear.”

Moreover, GSD organizational leaders need to ensure they optimize the teams and groups they manage. Participants CP1 and DP4 noted the need to break down barriers between staff and departments. CP1 explained “we usually hold quarterly town-hall meetings where share experiences and break down the barriers between departments.” Moreover, DP5 shared that they regularly hold “inter-departmental meetings to share ideas and information on a project is encouraged.” FP2 elaborated that “the company breaks barriers through long-term strategies of collaborative working to facilitate teamwork and positive group engagement.” Eliminating slogans was essential as DP2 noted that “using posters and exhortations on workers create adversarial relationships.” Also, EP3 indicated that “leaders need to avoid slogans since nice-sounding phrases should not replace effective organizational leadership and people management.” For people in management, FP4 shared the need to eliminate numerical quotas because they focus on quantity which “results in poor product quality in product and service development.” Thus, these findings emphasize the need by GSD leaders to ensure they have appropriate personnel management strategies to achieve desired software product quality.

Theme 4: Promote Autonomy and Personal Worker Development

Ensuring employee development and autonomy was another key theme that GSD leaders found helpful for achieving software product quality. CP3 and FP1 noted the need for organizational leaders to remove barriers that rob employees of the pride of workmanship, such as eliminating the annual merit system and

ratings. AP5 shared that employee autonomy is facilitated by ensuring that “work plans are developed by every employee” and that they “the intended goals for the year.” FP4 noted that “every individual interest and every individual goal is aligned to the broad objectives to avoid unhealthy competition.”

Besides promoting individual autonomy and pride, GSD leaders also need to encourage self-improvement and education for all employees. BP4 indicated that leaders “facilitate a vigorous plan of education meant to improve skills for everyone.” DP2 also elaborated that “organizations do not only need people but the constant improvement in education to meet the changing competitive environment.” Finally, management needs to take responsibility for transformation, quality improvement and productivity. According to EP2, “management needs to provide quality improvement process towards active transformation.” FP1 shared that transformation is achieved when managers “use external consultants to perform quality improvements.” These insights indicate the need for GSD organizational leaders to promote worker autonomy, personnel development, and management responsibility in organizational transformation as approaches to long-term product quality.

Research Question 2

- The second main research question was: How can common understandings be achieved among GSD organizational Leaders? Findings from interview responses revealed the need to focus on three aspects related to (a) formulating effective life cycle and development techniques, (b) identifying problems early, and (c) formulating solutions to identified problems. Table 4 includes a summary of the themes pertaining to a common understanding from GSD leaders about issues associated with software quality development.

TABLE 4
THEMES: A COMMON UNDERSTANDING

Themes	Issues
Formulate lifecycle and development techniques	Identify an appropriate lifecycle, have suitable development methods, consider Agile, Waterfall, or Activate processes
Identify challenges	Collaboration issues, coordination of multiple groups, variation in time zones, quality monitoring problem, managing diverse workers and ensuring reliable communication.
Create solutions	Improve communication, break cultural barrier, automatic testing tools, education, self-improvement, standardization of processes

Theme 5: Formulate Lifecycle and Development Techniques

The interviews emphasized the importance of formulating appropriate lifecycle and development techniques with an emphasis on the use of agile technology. AP1 shared that “Agile enables us to do continuous incremental deliveries to the customer and it's effective because the customer is the center of whatever we do.” However, AP2 noted that in their organization they prefer Activates to Agile because “it improves the mission groundwork where you find out what, prepare the project, and you interview the client to get the requirement - you know what they want. That gives you an idea of what you're going to do.” CP3 also discussed the importance of having suitable development technology such as Agile that is “very operationalized since you develop, someone tests, and another remediates the issues known, then it goes back into the building.” According to FP1, every company uses unique quality management methods, such as Six Sigma and Waterfall in place of an agile development approach.

Theme 6: Identify Challenges

In-depth understanding of software product quality may also be achieved by identifying potential challenges in the organization. For example, AP1 and EP3 noted that GSD leaders need to be aware of potential challenges and issues, such as communication and cultural differences. AP1 noted that potential challenges include “knowledge and coordinating projects in different time zones [which] could be very complex because most of our meetings, we don't usually do it in a particular time zone.” According to BP2, “one of the challenges we encounter is too many tools that don't always work well together. In most of the companies, there are also security challenges to effective software development.” DP4 shared that “the challenge for distributed work is that you don't see if someone's goofing off as they are unsupervised.” FP1 noted that in their company “one of the biggest challenges is its quality assurance,” while CP5 noted that major challenges are “communication and coordination.” Given the unique challenges of every organization, interview participants noted that a key aspect of achieving software product quality is identifying potential challenges before they emerge and formulating suitable solutions.

Theme 7: Create Solutions

Solutions to problems is another important consideration for GSD leaders, such as developing new practices and identifying solutions to emerging or potential problems. According to AP1, potential solutions for GSD leaders may include “constant collaboration within the team and with the customer, and then using automation like Devox, REP in solving most of those problems. Improve our communication, break cultural barrier, improve coordination and then automation will help.” CP3 added that “the most important thing is standardization because standards will ensure a lot of things. If you have a standard, then it covers requirements, it covers quality, it covers security, it just covers a lot of things.” AP 3 noted that “what is most needed is a very organized structure, in terms of the codebase. In terms of the source code, an organized structure that supports multiple people working on the same thing.” CP5 noted a potential solution as “ensuring full implementation of quality management in software development.” BP2 further shared that “what is needed is more of the automated tools for testing,” while FP3 emphasized the need to institute education and self-improvement” to address emerging challenges in software product development and quality. Thus, GSD leaders need to consider potential solutions for each scenario emerging from each process of product and service development.

Research Question 3

The third research question was: How do GSD organizational Leaders predict software product quality outcome and process improvement? Findings indicated that the outcome of software product quality stems from examining it by considering seven quality considerations. These seven quality considerations include (a) Deming's quality management, (b) quality management method, (c) predictive software product quality, (d) software quality management, (e) internal and external software quality, (f) product quality, and (g) covering quality aspects. Together these ideas coalesced into the eighth major theme.

Theme 8. Focus on Product Quality

The seven quality considerations emerged from the data as the means for focusing on product quality and predicting the outcomes of software product quality. For example, CP3 agreed that “planning is very key, designing is key and coding, testing, and deploying [is] relevant to achieve [quality].” AP1 noted that product quality may be achieved through “requirement analysis in addition to system design, system development, deployment and maintenance. But because we use Agile methodologies ...we do it as the project progresses.” Therefore, a combination of approaches may be appropriate, as explained below.

Deming's quality management was an important approach expressed by participants for predicting the outcome of software quality development among GSD leaders. According to AP1, the product development is initiated and then “checks made and if there is any problem, the designs are rechecked.” However, CP3 noted that in their organization, they do not consider such quality outcome measures as Deming, “but they are part of the entire system. So, we have established policies, procedures and processes.” AP3 noted the need to develop “milestones to make sure that at every stage, what is expected of the design is complete

before we go to the next one. Some of them will call it agile.” Effective quality management methods such as Agile, Lean, and Six Sigma are useful for enhancing quality. FP1 also indicated that their company uses “Kanban because we have what we call Kanban Dashboards that are monitored at regular interval.” EP3 shared that “Deming's principle is one quality management method, we also consider TQM by Kaizen and Crosby, which are under the ISO 9000 and 9001.”

The GSD leaders also need to consider and apply new things to ensure software product quality and customer satisfaction in the GSD environment. CP4 noted that they use “Deming's tool in addition to automated testing, continuous delivery, and continuous deployment to ensure that the quality of the software is increased.” DP2 also discussed the importance of new approaches to facilitate “training of the developers, going into the market to see what improvement, getting feedback from users, from customers.” The interview participants also explained that they predict software product quality using the ISO/IEC 25000 series. For example, AP1 shared that this is “the newest standard and we use this model to predict software product quality such as maintainability, reliability, portability, and even maintenance.” BP4 also shared “We use ISO/IEC 25000 series to predict and ensure maintainability of the software.” CP5 said, “We use the capability maturity model CMM/ISO standards. I think is effective and covers all vital quality attributes.” DP3 noted that software quality is evaluated using “software development lifecycle which is more projected, and it's more structured since it easily flows from one stage to another when ensuring product quality”

Additional considerations by AP4 in software quality management include focusing on using “teams that are in different locations to reduce costs and to get the best of quality.” Further, CP3 shared that “the common understanding is having an effective solution that solves the problem at less cost using less resources. At the management level in terms of quality, they want to be sure that whatever solution is developed is quality.” Additional focus was on external and internal software quality where DP3 indicated that the process is “pretty technical ... a CTO, CIO, or CIS may only be interested in the business side of global software development leaving the middle-level management and the team to understand the technical part or technical components of global software development.” AP1 also indicated that the intention of the focus on product quality is to promote customer needs where BP2 noted that they “give it a higher weight because potentially that will tell us how effective or cost-effective the software is. Then the functionality of the software too, we give it a weight that is higher to achieve desired quality.” Therefore, GSD leaders need to ensure their models effectively predict product quality in line with established quality standards, such as ISO/IEC 25000, CMM/ISO standards, and other internal software development life cycle standards that align with company goals.

LIMITATIONS

The limitations of this study included: 1) Scope of the Case ;2) Use of qualitative exploratory case study;3) Participants privacy and security concerns; 4) Sampling bias;5) Participant environment during interview and rescheduling; 6) Different Time Zones. The research delimitation may suggest that participants are not adequate representation of the population of 200 from organizations because some provinces in Canada were left out of the study. The study included 30 participants from six Canadian organizations across six provinces. The data were primarily from semi-structured interviews due to the flexibility they offered in the exploratory interview process. Certain barriers were encountered during the recruitment of the professional participant for interviews. Responding to invitations from social media platforms was initially difficult because participants refused to accept invitations due to privacy and security concerns. Social media as recruiting platform could introduce some level of Sampling bias. However, it was noted that bias was unlikely to occur because of used purposeful sampling of technological inclined organizational leaders. It was observed that certain participants were distracted by family members during interviews. These interactions resulted into rescheduled interviews. The different Time Zones in Canada was a factor that impacted some few interviews’ sessions. Participants complained about availability and requested a change in interview time. The identified potential limitations to the thoroughness and depth of data collected were unlikely to have jeopardized the trustworthiness of the research findings.

RECOMMENDATION

Future researchers could expand the scope of study to other regions and geographical locations; compare, confirm or disconfirm findings using qualitative methodology for broader investigation. Other future research could involve Deming's quality management framework to conduct comparison of GSD management organization practices using a quantitative method. This may provide more insights on how GSD organization predict software quality using modern models or standards.

CONCLUSION

This research satisfied the Gap in existing literature by providing better understanding from GSD organization leaders in Canada. Furthermore, the research findings added knowledge that may guide practitioners and researchers in improving software product quality and customer satisfaction. In addition, the findings revealed that top management should commit to quality, adopt behavioral management practices, and use industry practices to evaluate and predict software product quality.

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